result of measuring rotation using the ESPC approach is more accurate and robust irrespective of the method of uneven illumination correction or translation correction approach. The result of the ESPC approach has therefore been used as a standard to verify the registration accuracy and compared with the other methods of estimating rotation, as shown in Fig. 5. The result of LPNCC in measuring the angle of rotation is very close to ESPC.

In conclusion, the registration of RNFL images is best when the uneven illumination correction using the wavelet approach is combined with phase correlation for correcting translation and ESPC for correcting rotational motion. This is of particular interest, as the improvement obtained through rotational motion correction will be significant in the case of mosaicing images used to form a larger field of view, which aids improvement in diagnostic tools. Recently, a method using the Harris-Stephen interest point detector for AO flood-illuminated assisted images has been described [40]. The authors applied cross-correlation between small windows of detected feature-points followed by an affine model to minimize a least-square criterion between reference and input image in order to estimate translation, rotation and scale. In our study, the registration approach did not rely on retinal features as these may or may not be detectable in RNFL images. We found that LPNCC could be an effective approach for registering the RNFL images, which is computationally efficient. It fails only in the case of very poor quality frames. Currently, it takes approximately 3-4 minutes and 1-2 minutes on an 8-core PC for the best possible processing using the ESPC and LPNCC methods respectively, which could be considered a barrier for clinical implementation. However, the code has not been optimized for speed, and carrying this out, together with advances in computer hardware would certainly solve this problem.

We have proposed the correlation of GLCM to compare the effectiveness of the different processing techniques. The correlation of GLCM showed a sharp fall-off followed by periodic ripples that were clearest after the best processing (wavelet based uneven illumination correction + PC + ESPC) was carried out. Texture analysis based on correlation of GLCM was further shown to be potentially useful as a measure of the nerve fiber structure. The method retains information on spatial structures and for images comprising repetitive texture patterns, such as RNFL images, the correlation of GLCM measured at four directions show periodic behavior with the period equal to the spacing between adjacent texture primitives. The next stage of our work will involve applying this processing to RNFL images acquired from patients. AO imaging could potentially help to recognize early glaucomatous damage and to identify patients who could benefit from more intensive observation and management.

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